Question 1

$$
\begin{aligned}
&P(4 \text{ of a kind}) = \frac{13 \times 48}{\binom{52}{4}} \\
\Rightarrow &P(4 \text{ of a kind}) \approx 0.00024 \\
&p = 0.00024 \\
\Rightarrow &\lambda = np = 10000 \times 0.00024 = 2.4 \\
&P(X = x) = \frac{e^{-\lambda}\lambda^x}{x!} \\
\Rightarrow &P(X \leqslant 2) = P(X = 0) + P(X = 1) + P(X = 2) \\
&P(X \leqslant 2) = \frac{e^{-2.4}2.4^0}{0!} + \frac{e^{-2.4}2.4^1}{1!} + \frac{e^{-2.4}2.4^2}{2!} \\
\Rightarrow &P(X \leqslant 2) = 0.569709
\end{aligned}
$$

Question 2

$$
\begin{aligned}
& p_X = 0.1 \\
& n = 400 \\
\Rightarrow & \mu_X = np = 40 \\
& \sigma_X = \sqrt{np_X(1-p_X)} = 6 \\
& \text{Use normal distribution} \\
& P(X \geqslant 48) \\
= & P(X \geqslant 48 - 0.5) \\
= & P(\frac{X-\mu_X}{\sigma_X} \geqslant \frac{47.5-40}{6}) \\
= & P(z \geqslant 1.25) \\
= & 1 - P(z < 1.25) \\
= & 1 - 0.8944 \\
= & 0.1056 \\
& p_Y = 0.0025 \\
\Rightarrow & \mu_Y = 1 \\
& \text{Use Poisson distribution} \\
& P(Y \geqslant 2) \\
= & 1 - (P(Y=0) + P(Y=1)) \\
= & 1 - (\frac{e^{-1} \times 1^0}{0!} + \frac{e^{-1} \times 1^1}{1!}) \\
= & 1 - (0.36788 + 0.36788) \\
= & 0.2642
\end{aligned}
$$